WHAT IS CLAIMED IS:

1. A time-of-flight mass analyzer comprising:

an ionizer adapted to provide ions of a sample substance to be analyzed;

a flight tube accepting ions provided from the ionizer, said flight tube adapted to constrain said ions to a substantially helical ion flight path using a generally static electric field;

an ion detector disposed to detect ions exiting said flight tube;

at least one timer adapted to determine the flight time of said ion along an ion path that comprises at least said substantially helical ion path.

2. A time-of-flight mass analyzer as claimed in claim 1 wherein said ionizer is integrated with said flight tube.

3. A time-of-flight mass analyzer as claimed in claim 1 wherein said substantially helical ion path is defined by a linear axis, said ions being provided to said flight tube with a velocity component in the direction of said linear axis.

4. A time-of-flight mass analyzer as claimed in claim 1 wherein said substantially helical ion path is defined by a linear axis, said ions being provided to said flight tube with a negligible velocity component in the direction of said linear axis

whereby said ions initially remain circulating in a region proximate an input of said flight tube.

5. A time-of-flight mass analyzer as claimed in claim 4 and further comprising:

an electrode disposed for use in generating an electric field that imparts a velocity component in a direction along said linear axis to said ions whereby said ions move away from said region proximate the input of said flight tube.

6. A time-of-flight mass analyzer as claimed in claim 1 wherein said flight tube comprises:

an inlet portion having an ion inlet, said inlet portion being substantially free of electric fields;

an ion deflection portion having a substantially static electric field, said ion deflection portion being adapted to direct ions received from said inlet portion along said substantially helical ion flight path.

7. A time-of-flight analyzer as claimed in claim 6 and further comprising:

at least one power supply connected to said flight tube to generate a first generally static electric field in said ion deflection portion, said power supply further being alternately operable between at least a first state in which said inlet portion is substantially free of electric fields, and a second state in which a second generally static electric field is generated in said inlet portion.

8. A time-of-flight mass analyzer as claimed in claim 7 wherein said first and second generally static electric fields have substantially the same magnitude.

9. A time-of-flight mass analyzer as claimed in claim 1 wherein said flight tube comprises:

a first electrode having a generally cylindrical electrode surface facing an interior portion thereof, said first electrode further having an ion inlet disposed through a side thereof;

a second electrode having a generally cylindrical electrode surface facing an exterior portion thereof, said second electrode being concentrically disposed with said first electrode, said second electrode further having an opening along an arcuate portion of the electrode surface in a region to form an ion inlet; and

a third electrode having an arcuate electrode surface facing an exterior portion thereof, said third electrode being disposed in said arcuate opening of said second cylindrical electrode.

10. A time-of-flight mass analyzer as claimed in claim 9 and further comprising:

at least one power supply connected to said first, second and third electrodes, said power supply being operable to generate a first generally static electric field between said first and second electrodes, said power supply further being alternately operable between at least a first state in which the region between said first and third electrodes proximate said ion inlet is generally field free, and a second state in which a second generally static electric field is generated in the region between said first electrode and said second and third electrodes.

11. A time-of-flight mass analyzer as claimed in claim 10 wherein said first and second generally static electric fields have substantially the same magnitude.

12. A time-of-flight mass analyzer as claimed in claim 10 wherein said ions are provided to said flight tube at a predetermined kinetic energy.

13. A time-of-flight mass analyzer as claimed in claim 12 wherein the magnitude of said first generally static electric field is selected based on said predetermined kinetic energy to guide said ions into a stable trajectory along said substantially helical ion flight path.

14. A time-of-flight mass analyzer as claimed in claim 13 wherein said first and second generally static electric fields have substantially the same magnitude.

15. A flight tube arrangement for use in a time-of-flight mass analyzer comprising:

a first electrode having a generally cylindrical electrode surface facing an interior portion thereof, said first electrode further having an ion inlet disposed through a side thereof;

a second electrode having a generally cylindrical electrode surface facing an exterior portion thereof, said second electrode being concentrically disposed with said first cylindrical electrode, said second electrode further having an opening through an arcuate portion of the electrode surface at least in a region proximate said ion inlet;

a third electrode having an arcuate electrode surface facing an exterior portion thereof, said third electrode being disposed in said arcuate opening of said second electrode; and

at least one power supply connected to said first, second and third electrodes, said power supply being operable to generate a generally static electric field between said first and second electrodes, said power supply further being alternately operable between at least a first state in which the region between said first and third electrodes proximate said ion inlet is generally field free, and a second state in which a generally static electric field is generated in the region between said first electrode and said second and third electrodes.

16. A flight tube for use in a time-of-flight mass analyzer comprising:

an inlet portion adapted to direct ions received thereat to a region that is substantially free of electric fields;

an ion deflection portion having a substantially static electric field, said ion deflection portion being adapted to direct ions received from said inlet portion along a generally helical ion flight path defined by said substantially static electric field.

17. A method for routing ions in a time-of-flight mass analyzer comprising:

introducing said ions to an ion flight path, at least a portion of said ion flight path being defined by a linear axis;

directing ions introduced to said ion flight path into a region of said ion flight path that has a substantially static electric field, said substantially static electric field having non-linear equipotential field lines that circumvent said linear axis;

providing said ions with a velocity component along said linear axis, said ions making multiple circumnavigating trips along a path defined by said non-linear equipotential field lines as said ions further travel in the direction of said linear axis.

18. A method as claimed in claim 17 wherein said ions travel along a substantially helical ion flight path when provided with said velocity component along said linear axis.

19. A time-of-flight mass analyzer comprising:

an ionizer adapted to generate ions of a sample substance to be analyzed;

a flight tube having at least one linear portion defined by a linear axis, said flight tube further having an input region accepting ions generated by the ionizer, said flight tube adapted to constrain said ions in a substantially static electric field having non-linear equipotential field lines that circumvent said linear axis;

said ions being provided to said input region of said flight tube at an angle that is tangential to said equipotential field lines of said substantially static electric field to thereby initially trap said ions in said input region of said flight tube;

an electrode disposed for use in generating an electric field that imparts a velocity component along said linear axis to said ions whereby said ions move away from said input region of said flight tube;

an ion detector disposed to detect ions exiting said flight tube;

at least one timer adapted to determine the flight time of said ions along an ion path that comprises at least said flight tube.

20. A time-of-flight mass analyzer as claimed in claim 19 wherein said ionizer is integrated with said flight tube.

21. A time-of-flight mass analyzer as claimed in claim 19 wherein said ions make multiple circumnavigating trips along a path defined by said non-linear equipotential field lines as said ions further travel in the direction of said linear axis.

22. A time-of-flight mass analyzer as claimed in claim 21 wherein said ions travel along a substantially helical ion flight path.